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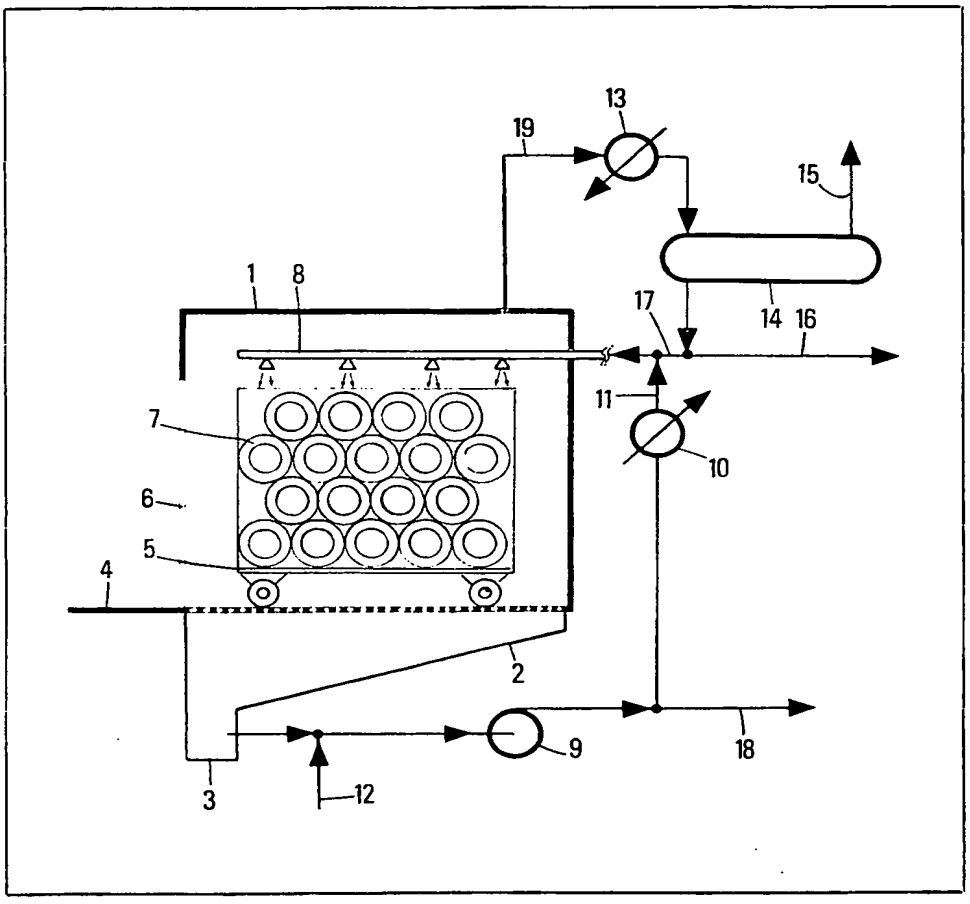
(54) Conversion of unwanted tyres to liquid gaseous material

(57) Used or waste tyres (7) are heated in an oven (1) while a stream of heavy hydrocarbon oil is sprayed thereon. Part of the oil is recycled and the oil formed by decomposition of the tyres (7) is discharged as an output product.



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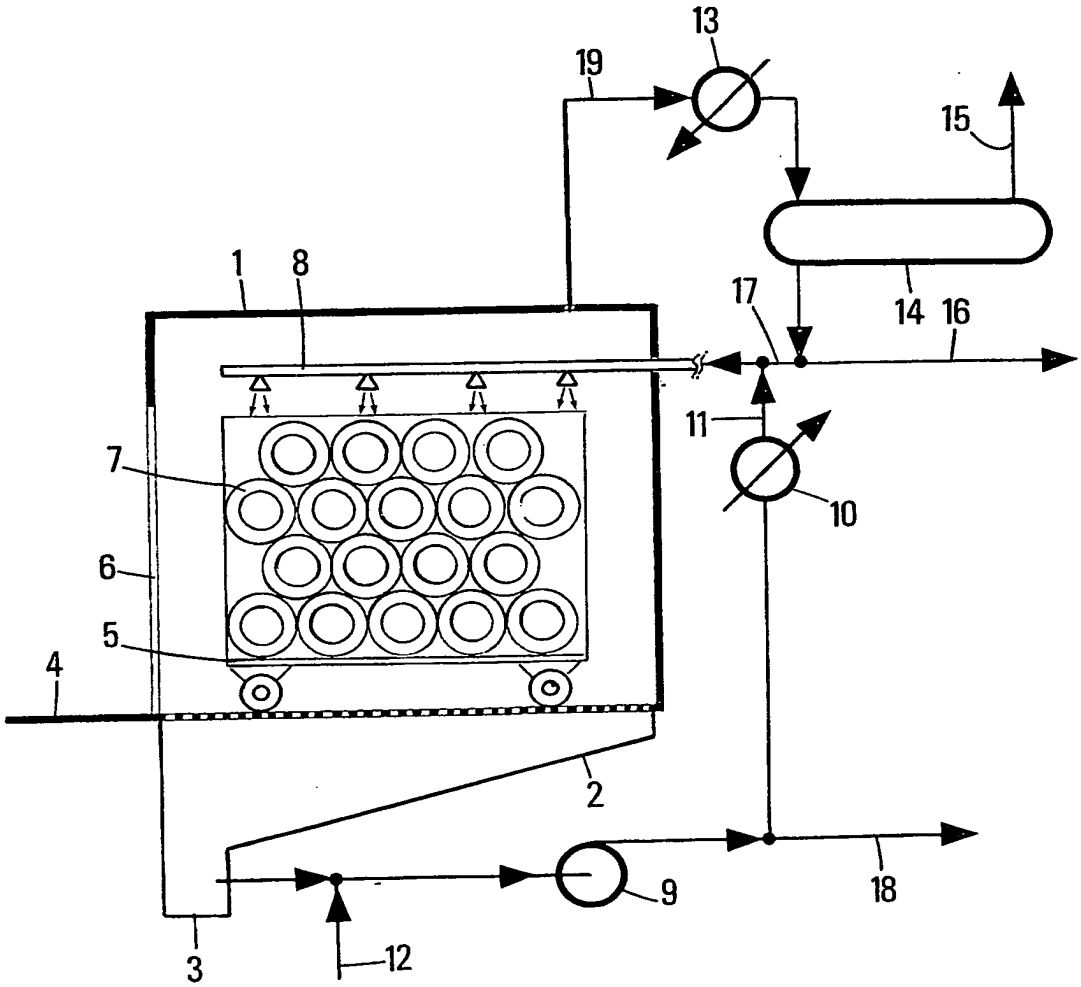

SPECIFICATION

Conversion of unwanted tyres to liquid and gaseous materials

This invention relates to the conversion of unwanted (e.g. used or waste) tyres to liquid and gaseous materials which may be used, for example, as fuels.

The disposal of used, wasted or other scrap or unwanted tyres has become a major problem. The most common way to get rid of them is to throw them away or, in some cases, to burn them in the open air, thus releasing substantial amounts of carbon and polluting gas into the atmosphere. Other techniques have been considered, but they are unable, separately or together, to consume the huge quantity of unwanted tyres that are in existence. The problem is the more serious as the number of scrap tyres in the world is continuously increasing and is presently equal to several hundreds of millions per year.

A known tyre conversion technique is pyrolysis. It is effected at a high temperature and its complexity necessitates the use of production units of large capacity, which is hardly compatible with a limited supply in any particular area due to high collection and transportation costs.

Another known technique comprises cutting the tyres into fragments of various sizes, heating the fragments in a heavy oil at a temperature of from about 300 to 500°C and recovering the products thereby formed. The tyre cutting step represents a substantial part of the cost of the operation, particularly when the tyres have metallic casings and/or are of large size.

The treatment of whole tyres by an immersion technique would require the use of a large quantity of oil, amounting to about 8 to 10 times the weight of the tyres. The use of such an amount of oil results in the serious disadvantages of delay in starting the treatment installation or apparatus and high power consumption for heating the oil up to the reaction temperature, particularly in batchwise operated installations which are less suited to heat recovery than continuously operated installations.

Another difficulty arises from foam formation in the apparatus where the tyres are heated, which foam makes it necessary to proceed slowly in order to avoid obstruction of the apparatus, but the corresponding treatment time at high temperature too largely favours cracking and formation of gas to the detriment of liquid fuel.

According to the present invention there is provided a process for converting unwanted tyres to liquid and gaseous materials by heating them in the presence of hydrocarbon oil, wherein the tyres are treated with the oil according to a streaming technique.

A process embodying the invention and described hereinbelow provides for a mode of operation which is less costly than the preceding ones, which is more suited to local scale exploitation, and which can enable the above-mentioned disadvantages, particularly cutting up of the tyres, the accumulation of foam and the requirement of a large collection network, to be avoided or at least reduced. According to the process embodying the invention, rough fragments or, preferably, whole unwanted tyres are treated by means of a heavy oil streaming thereon, i.e. without immersing them in a bath of such oil.

The technique of the process embodying the invention has several advantages:

investment costs are reduced by the (optional) omission of the step of cutting up the tyres;

the use of a lesser amount of oil, and the consequent smaller consumption of heating power;

a higher rate of gum decomposition, the streaming technique improving solid-liquid transfer; and

removal of the disadvantages due to the accumulation of foam, as a result of the lower relative volume of liquid phase.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawing, the sole figure of which is a diagrammatic representation of an installation for carrying out a tyre conversion process embodying the invention.

The illustrated installation comprises an enclosure 1 whose lower part 2 is inclined and leads to a sump or tank 3. A roller track 4 permits a carriage 5 to enter the enclosure 1 via a tightly-fitting door 6. The carriage 5 contains tyres 7 and the walls of the carriage are so designed as to permit streaming oil to pass through them while retaining the tyres in place. These walls preferably comprise a wire lattice.

One or more spray tubes such as a tube 8 are disposed above and/or on the sides of the enclosure 1 and are oriented towards the location of the tyres 7.

The installation is operated as follows:

After a carriage 5, loaded with used or waste or otherwise unwanted tyres 7, has been placed in the enclosure 1 and the door 6 has been closed, a pump 9 is operated so as to suck hydrocarbon oil from the sump or tank 3 and to supply it through a heater 10 and a line 11 to the spray tube 8. Fresh oil may be supplied through a line 12. Oil is projected onto the tyres 7, freely streams, runs or trickles thereon and is collected in the tank 3, from which it is withdrawn again by the pump 9. When the tyres 7 have attained their decomposition temperature, which is about 350 to 500°C, the volatile compounds distil through a line 19 and are condensed in a

cooler 13 and fed to a drum 14. The gases escape through a line 15 and the liquid phase may be discharged through a line 16 and/or wholly or partially recycled through a line 17.

The dissolution and/or decompositoin of the tyres 7 results in the production of oil. Accordingly, a portion of the circulating oil is discharged through a line 18. It may be advantageous to dilute the oil in the line 18 with a portion of the condensed phase from the line 16 (preferably after withdrawal therefrom of a fraction boiling within the gasoline range). The discharged oil is thus one of the output products and the tyre conversion process. It may be used as fuel in a heater or for any other purpose. A portion of the oil may however be kept for being added to the fresh oil in a subsequent operation.

Once the operation has been completed, the carriage 5—which then contains the undecomposed casings of the tyres 7—is taken out of the enclosure 1 and a new load of used or waste tyres is introduced under adequate security conditions.

In carrying out the process one can use, by way of example, 1 to 8 parts by weight of oil per part by weight of tyres and preferably, 1.5 to 4 parts by weight of oil per part by weight of tyres. This small proportion of oil is one of the advantages of the present process in view of the fact that with whole tyres the usual treatment requires 8 to 10 parts by weight of oil per part by weight of tyres to form an immersion bath according to the known technique.

It has been found that the spraying rate has a substantial effect on the process. Spraying rates of 5 to 100 m^3/h (preferably 10 to 50 m^3/h) per tonne of tyres are preferred. Too low rates result in irregularities of the treatment and in coke deposit in heat exchangers used in the treatment installation, whereas too high rates result in increased operating costs and in more rapid wear of the installation, without additional advantage for the treatment process itself.

The oil may be any hydrocarbon oil, provided it remains liquid at the operating temperature. Any hydrocarbon oil proposed in the prior art may be convenient, although preferred oils are those containing at least 20% of aromatic or naphthenic hydrocarbons.

Although the use of carriages is preferred in view of their ease of use, any other loading and unloading equipment, for example an elevated conveyor, may be used, including a loading in bulk.

The invention is neither limited to the treatment of particular type of tyre, nor to particular operating conditions, the operating conditions being those usually proposed in the prior art.

An example of a process embodying the invention is given below:

EXAMPLE

Whole tyres to be treated are arranged in a basket carried in a carriage which is introduced into an oven. An inert atmosphere (nitrogen or steam) is established and a hydrocarbon oil of aromatic type is circulated so as to supply the heat required for degradation of the tyres. The oil flow rate is 25 m^3 per tonne of tyres. The temperature is 390°C. The volatile products are allowed to distil and the liquid fractions (gasoline and heavier distillates) are condensed. When the operation is completed, the circulating oil is allowed to cool down and is diluted with the condensed fractions distilling after gasoline.

The properties of the produced combustible oil are given below:

– viscosity at 50°C (mm^2/s)	2.83×10^{-4}
– pour point (°C)	− 12
– Conradson carbon (% by weight)	15
– zinc (% by weight)	0.56
– S (% by weight)*	3.8

* Depends to a very large extent on the contact oil. The oil used for the test had a sulphur content of 4.9%.

CLAIMS

1. A process for converting unwanted tyres to liquid and gaseous materials by heating them in the presence of hydrocarbon oil, wherein the tyres are treated with the oil according to a streaming technique.
2. A process according to claim 1, wherein the rate of streaming the oil is from 5 to 100 m^3/h per tonne of tyres.
3. A process according to claim 1, wherein the rate of streaming of the oil is from 10 to 50 m^3/h per tonne of tyres.
4. A process according to any one of claims 1 to 3, wherein 1.5 to 4 parts by weight of fresh plus recycled oil are used per part by weight of tyre.
5. A process according to any one of the preceding claims, wherein a part of the oil recovered after streaming is recycled and another part is discharged as an output product.
6. A process according to any one of the preceding claims, wherein vapours formed during the heating are condensed and at least a portion of the condensate is admixed with discharged oil.
7. A process according to any one of the preceding claims, wherein the tyres are arranged in a carriage whose walls allow the oil to pass therethrough.
8. A process according to any one of the preceding claims, which is conducted in an enclosure provided with spray means at its top and on at least a portion of its walls and comprising at its bottom a sump for collecting liquid, pump means being provided to raise collected liquid up to the spray means.

9. A process according to any one of the preceding claims, wherein whole tyres are treated without being cut into pieces.

10. A process for converting unwanted tyres to liquid and gaseous materials, the process being substantially as herein described with reference to the accompanying drawings.

11. A process for converting unwanted tyres to liquid and gaseous materials, the process being substantially as set forth in the preceding Example.

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